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ABSTRACT

An instructor's manual and student activity guide on arc welding are provided in this set of prevocational education materials which focuses on the vocational area of trade and industry. (This set of materials is one of ninety-two prevocational education sets arranged around a cluster of seven vocational offerings: agriculture, home economics, distributive education, health occupations, world of work, trade and industry, and office occupations.) The instructor's guide is organized into the following elements: title of activity, duration of activity (three to seven periods), activity goals, eleven instructional objectives, related vocational clusters, and activity implementation (description, safety precautions, materials needed, teacher preparation prior to class, during the class, follow-up activities, and masters for duplication). The student activity guide provides step-by-step instructions (narrative and illustrations) for completing each instructional objective. At the end of each set of instructions is a student check point (evaluation activity). Occupational descriptions for arc welders and cutters conclude the document. (JH)

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ED169375

T & I – ARC WELDING

Kit No. 86

INSTRUCTOR'S MANUAL

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In Cooperation With

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1978

CE 020 560

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TITLE OF ACTIVITY

Kit No. 86, T & I – Arc Welding

DURATION

Main Activity: 2 – 4 periods
Follow-up Activity: 1 – 3 periods

GOALS

The student will measure and cut the materials to the proper size.

The student will assemble and weld the materials in the correct place.

INSTRUCTIONAL OJBECTIVES

Given an 18 inch (45.7 cm) ruler and a scratch awl, the student will measure and mark 5 inches (12.7 cm) on the piece of flat iron.

Given a hacksaw, the student will cut the flat iron on the mark.

Given an 18 inch (45.7 cm) ruler and scratch awl, the student will measure and mark 18 inches (45.7 cm) on the piece of flat iron.

Given a hacksaw, the student will cut the flat iron on the mark.

Given the necessary tools and equipment, the student will bend the metal pieces into proper form.

Given a ruler and scratch awl, the student will measure and mark the centers of both 18 inch (45.7 cm) pieces of metal.

Given the proper tools and equipment, the student will prepare the stand to be welded.

Given an arc welder and personal protective devices, the student will set up the arc welder for welding.

Given the welder, the student will strike an arc and weld the various pieces of metal together.

Given a chipping hammer and safety goggles, the student will clean and inspect the welds.

Given the necessary materials and instructions, the student will form the base of the trash can holder.

VOCATIONAL CLUSTERS

Trade and Industry, Welding; Health

ACTIVITY IMPLEMENTATION

A. Description

The student will learn fundamentals about welding by building a trash can holder. The student will also bend metal to form some of the parts.

B. Safety

Handle tools carefully to avoid injury to yourself or others.

Wear safety glasses while working with the metal.

Wear a welding helmet when welding.

Tell others not to watch while you are welding. You can be blinded by prolonged exposure to the white light of arc welding.

Handle metal carefully after welding because it will be hot; wear leather gloves.

C. Materials

1. Audio Visual Equipment:

   None

2. Technical Equipment:

   25 rulers, 18 inch (45.7 cm)
   4 hacksaws
   4 welding clamps
   4 welding helmets with No. 12 lens
   2 arc welders, 110 volt
   2 chipping hammers
   4 vises
   4 scratch awls
   2 pipe wrenches, 8 inch
   13 pairs of safety goggles
   2 pairs leather gloves
   2 leather aprons
   2 welding screens
   13 try squares

3. Expendable Materials:

   1 inch (2.54 cm) pipe 4 feet (1.22

m) long, not galvanized
1 piece 1/8 x 3/4 inch x 4 feet (.3175 x 1.905 cm x 1.22 m) flat iron
1 cap 1 inch (2.54 cm), if desired for the top of the pipe

General Expendable Supplies:

extra hacksaw blades
welding rods for lightweight metal

D. Preparation Prior to Class

Obtain expendable materials.

Caution is the best rule to follow when welding.

Assume all metal is hot and always handle metal around the welding area with leather gloves.

In preparation for this activity it would be to your advantage to set this activity up outside, utilizing a welding table. If you do use this activity indoors, weld only on a concrete surface. Do not weld on a wood desk top surface; the heat produced from this process will cause any wood substance to burn. Pick an area in your room where the actual welding will take place and set up two screens to protect your class from the harmful light of the arc welder.

E. During Class Sessions

Introduction

Welding is a method of fusing metal together. This joining of metal is done by heating the two pieces of metal which causes the metal to run together to form one piece. A filler metal is added to the original metal by the use of a welding rod. This also adds strength to the metal. There are about 40 different processes of welding. The four most common are (1) Arc Welding, (2) Resistance Welding (spot welding), (3) Gas Welding, and (4) Brazing.

Arc Welding is the joining of metal with an electric arc.

Spot Welding is joining metal by heating the metal in a spot.

Gas Welding is when one uses gas to provide the heat to melt the metal.

Brazing is using a filler metal to join the pieces together but the metal is not heated enough to melt the parts.

These are different types of welding; now you are going to do some arc welding.

When arc welding, you need to be careful to avoid injury to yourself. Handle the metal carefully because it becomes hot when welding. Particles of metal come from the welding surface and could burn you if they hit you. Therefore, long sleeves should be worn for protection. Observe all safety rules.

To the Instructor

After students start working, move around the class to supervise their work and answer questions.

F. Follow-up Activities

1. Have students complete a VIEW Fact Sheet.
2. Tour place where welding is done.
3. Tour Vocational School welding shop.

MASTERS FOR DUPLICATION

VIEW Fact Sheet

VIEW FACT SHEET

NAME _____ CLASS _____ OCCUPATION _____

A. List the advantages (good points) of this occupation (job).

B. List the disadvantages (bad points) of this occupation (job).

C. List three things you should know to do this occupation (job).
1.
2.
3.

D. What type of education should you get to be prepared (do) for this occupation (job)?

E. What courses must you take to go into this occupation (job)?

F. What do you think your future in this occupation (job) will be?

G. What wage can you expect in this occupation (job)?

H. What are the working hours of this occupation (job)?

I. To learn more about this occupation (job), write to:

J. Using a scale of 1 to 5, circle the number that measures your interest in this occupation (job) as a possible career.

I don't like it. ← 1 2 3 4 5 → I like it.

T & I – ARC WELDING

Kit No. 86

STUDENT

LEARNING ACTIVITY GUIDE

Prepared by

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T & I – ARC WELDING

INTRODUCTION

The student will use the proper tools and equipment to build a trash can holder.

GOALS

The student will measure and cut the material to the proper length.

The student will assemble the material to make the trash can holder.

DIRECTIONS

Read through the complete booklet before starting the project.

Handle the tools carefully to avoid injury to yourself or others.

Wear welding helmet when welding.

Tell other students not to watch when you are welding – you can be blinded by prolonged exposure to the white light of arc welding.

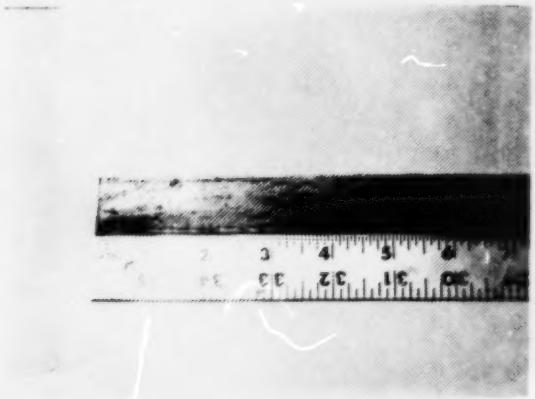
Wear safety glasses while cutting and bending the metal.

MATERIALS

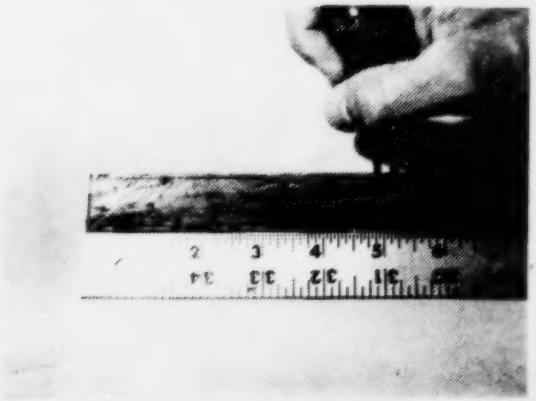
1 piece 1 inch (2.54 cm) pipe 4 feet (1.22 m) long, not galvanized
1 piece 1/8 x 3/4 inch x 4 feet (.3175 x 1.905 cm x 1.22 m) flat iron
18 inch (45.7 cm) ruler
hacksaw
welding clamp
welding rod
welding helmet No. 12 lens
arc welder
hammer
vise
scratch awl
safety glasses
pipe wrench
cap, 1 inch for pipe, if desired
gloves
leather apron
try square

Instructional Objective 1

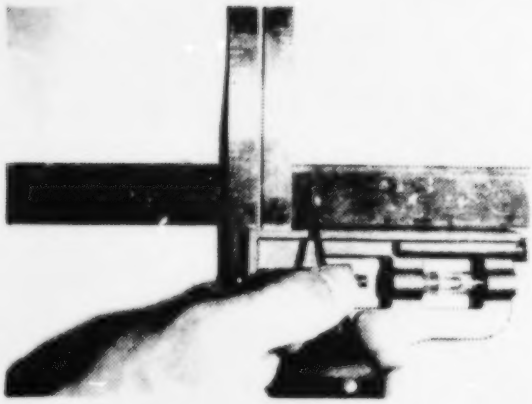
Given an 18 inch (45.7 cm) ruler and scratch awl, the student will measure and mark five inches (12.7 cm) on the piece of flat iron.



STEP 1 — Place the ruler and metal side by side so the bottoms of each are even.



STEP 2 — Using a scratch awl, strike a mark beside the large number 5 on the ruler.



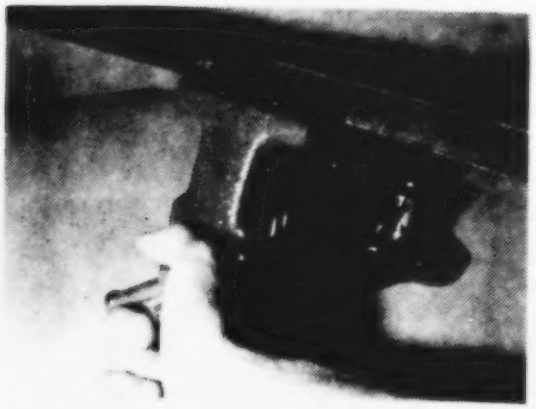
STEP 3 — Take a try square at this 5 inch (12.7 cm) point, and strike a line across the metal with the awl.

Check Point

Have one of your fellow workers check your measurement.

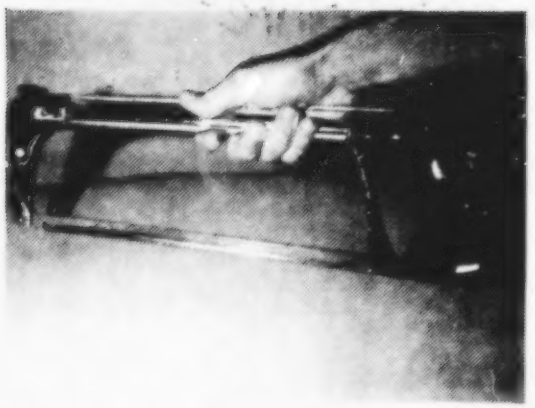
Instructional Objective II

Given a hacksaw, the student will cut the flat iron on the mark.

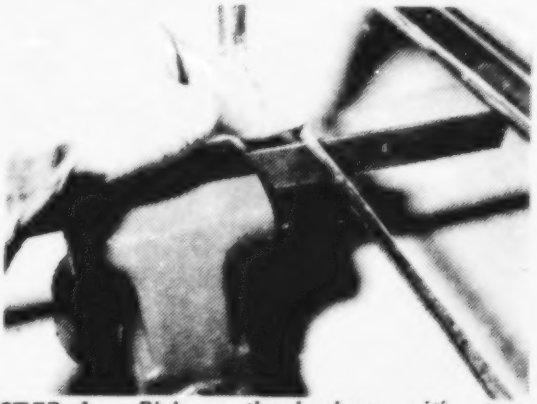


STEP 1 – Place the metal in the vise so the piece to be cut extends past the jaws of the vise.

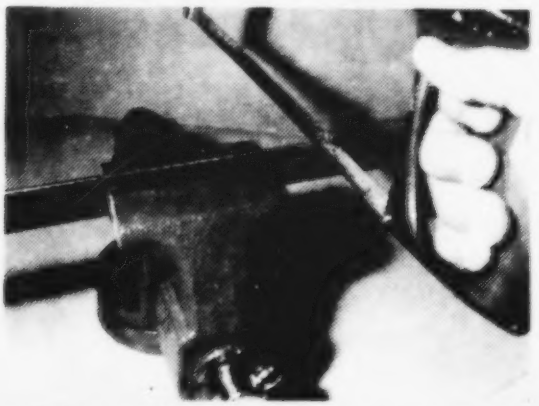
STEP 2 – Tighten the vise so the metal is secure.



STEP 3 – Check hacksaw prior to use to make sure the blade is pointing forwards. Remember the blade only cuts in one direction. Look for the teeth and arrow on the blade pointing away from the handle.



STEP 4 – Pick up the hacksaw with your right hand and guide the blade over the metal surface with your left hand. (Do the opposite directions if you are left handed.)



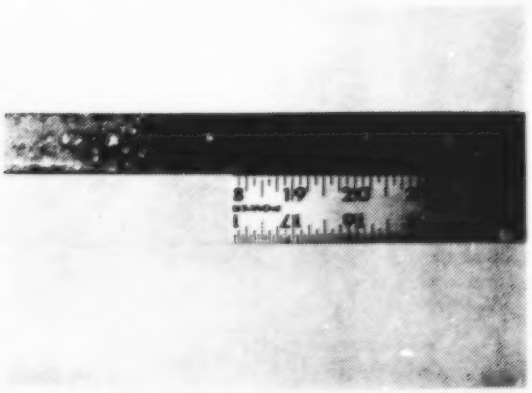
STEP 5 – Cut the metal by using even strokes across the surface. Do not apply excessive pressure on the blade because it will not cut any quicker and you could injure yourself if a blade breaks.

Check Point

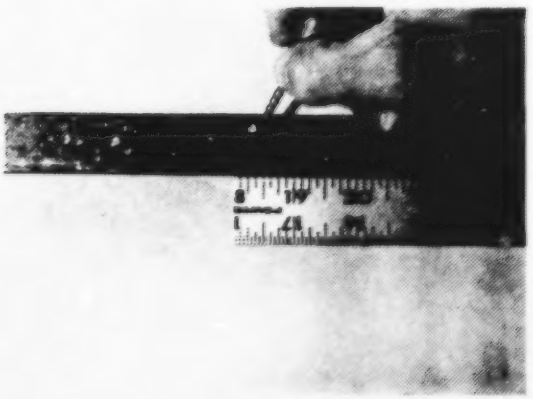
Repeat objectives one and two until you have cut two pieces 5 inches (12.7 cm) long.

Instructional Objective III

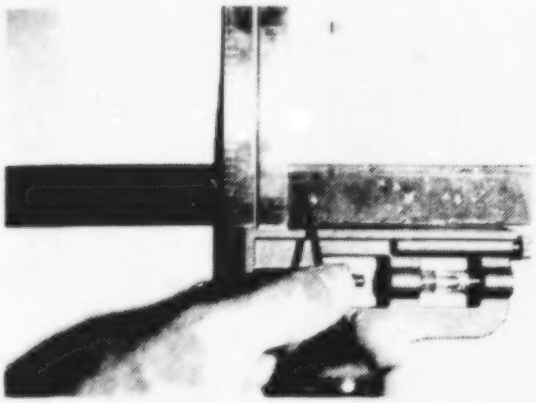
Given an 18 inch (45.7 cm) ruler and scratch awl, the student will measure and mark 18 inches (45.7 cm) on the piece of flat iron.



STEP 1 – Place 18 inch (45.7 cm) ruler so that the bottoms of both the ruler and metal are even.



STEP 2 – Strike a mark at the end of the 18 inch (45.7 cm) ruler.



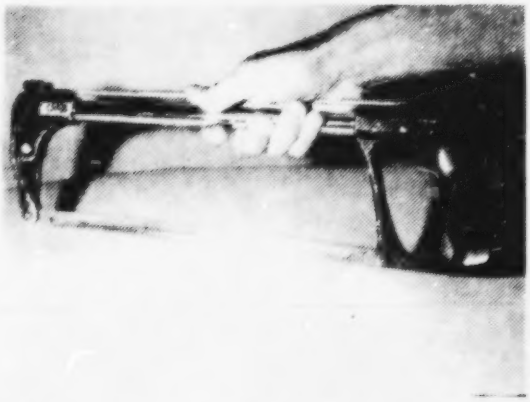
STEP 3 – Using a try square, strike a line across the 18 inch (45.7 cm) mark. (Use the same procedure as in Objective I, step 3.)

Check Point

Have one of your co-workers check your measurement.

Instructional Objective IV

Given a hacksaw, the student will cut the flat iron on the mark.



STEP 1 – Repeat Instructional Objective II. Follow all the steps and include the checkpoint.

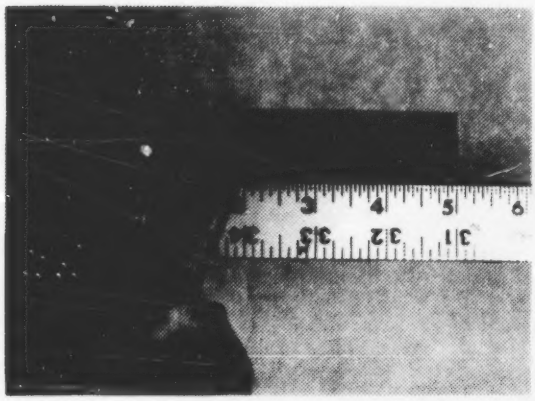
Check Point

Repeat Objectives III and IV so you will have two 18 inch (45.7 cm) pieces of metal.

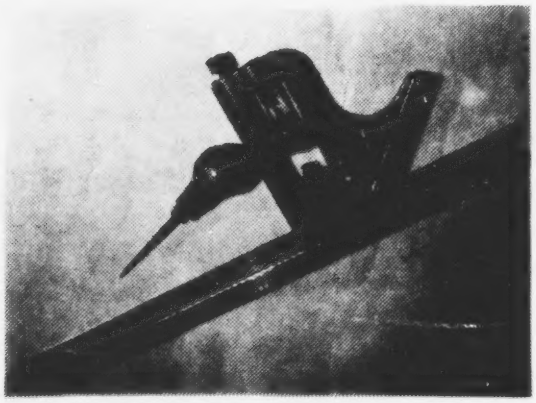
Show the teacher the pieces you have cut.

Instructional Objective V

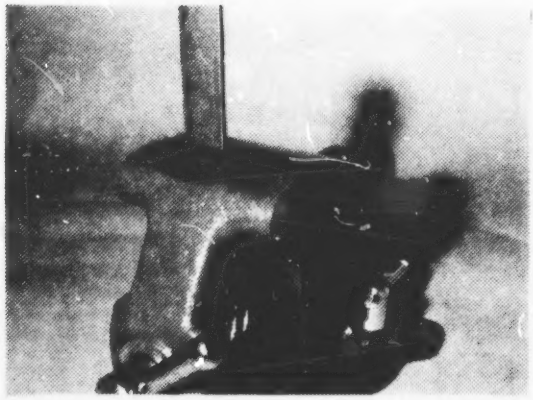
Given the necessary tools and equipment, the student will bend the metal pieces into proper form.



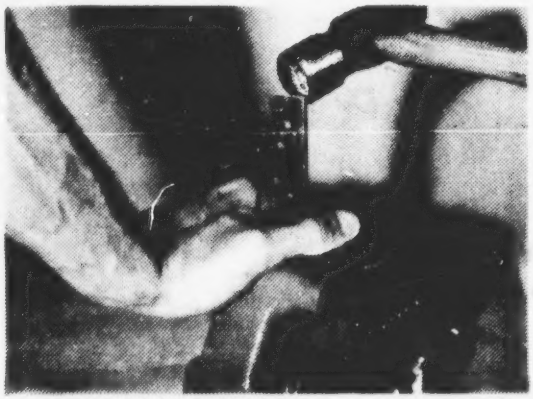
STEP 1 – The student will measure 2 inches (5.08 cm) from each of the 5 inch (12.7 cm) pieces of flat iron.



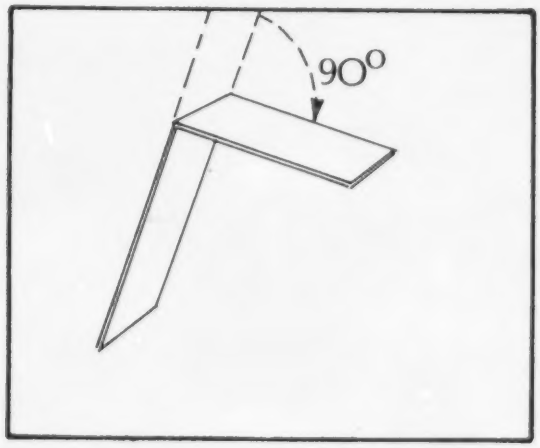
STEP 2 – Follow the past procedure in marking your metal with an awl and try square.



STEP 3 – Place the iron in the vise so the mark is above the top of the jaws.



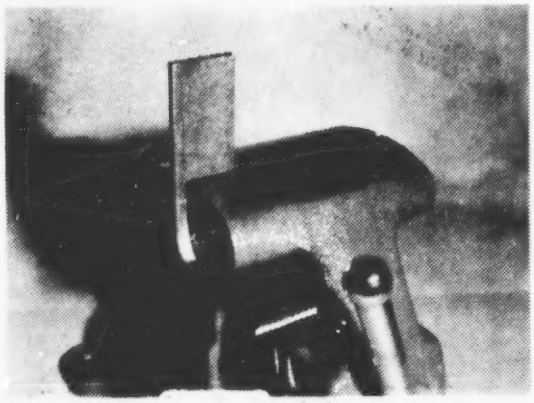
STEP 4 – Start bending the iron by holding it with your hand and hitting it with the hammer.



STEP 5 – Continue the hammering until you have a 90 degree angle.

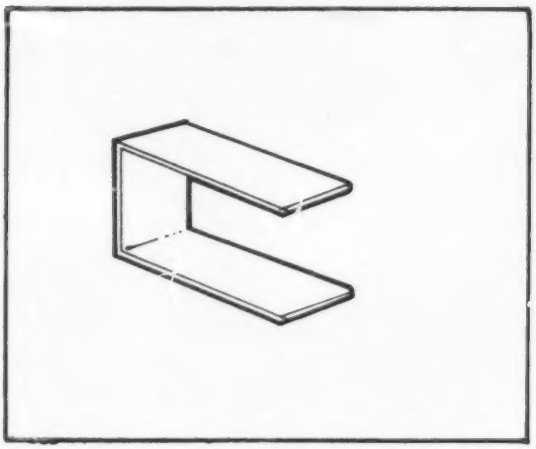
Check Point

Remove the metal from the vise and ask one of your fellow students to check the accuracy of the bend.

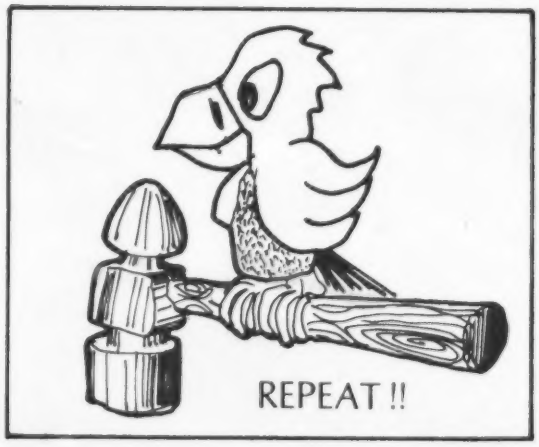


STEP 6 – Line up the other 2 inch (5.08 cm) mark in the vise so that the bent section is pointing toward you.

STEP 7 – Tighten the metal in the vise and follow steps 4 and 5.



STEP 8 – The formed metal should look like the shape above.



STEP 9 – Repeat steps 1 – 8 to form the second 5 inch (12.7 cm) piece of metal.

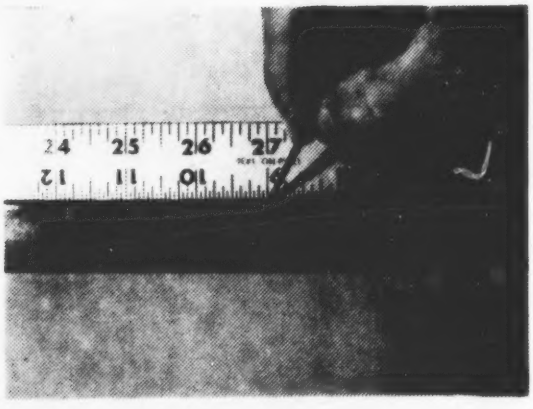
Check Point

Show the teacher the pieces you have bent.

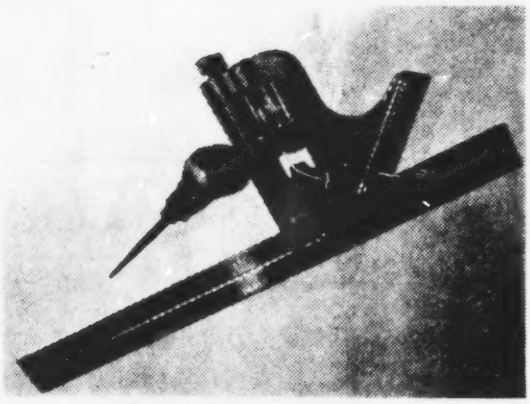
Instructional Objective VI

Given a ruler and scratch awl, the student will measure and mark the centers of both 18 inch (45.7 cm) pieces of metal.

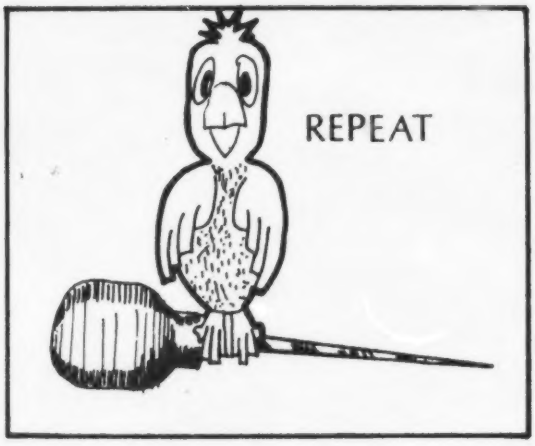
STEP 1 – Line up the ends of the ruler and 18 inch (45.7 cm) piece of metal so they are even.



STEP 2 – Using a scratch awl, mark the metal at the 9 inch (22.86 cm) measurement of the ruler.



STEP 3 – Using a try square and scratch awl, score a line across the metal at this 9 inch (22.86 cm) mark.



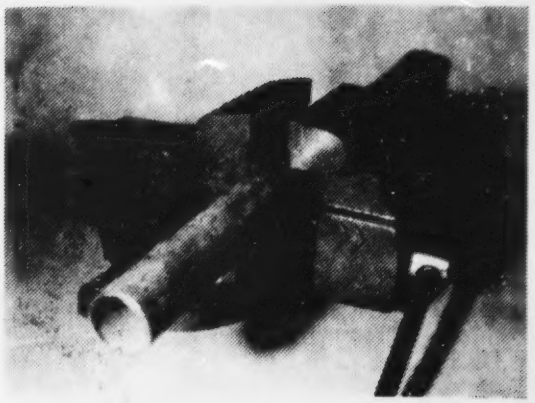
STEP 4 – Repeat steps 1 – 3 to mark the other 18 inch (45.7 cm) piece of metal.

Check Point

Have a fellow student check your work by remeasuring the center points of both pieces of metal.

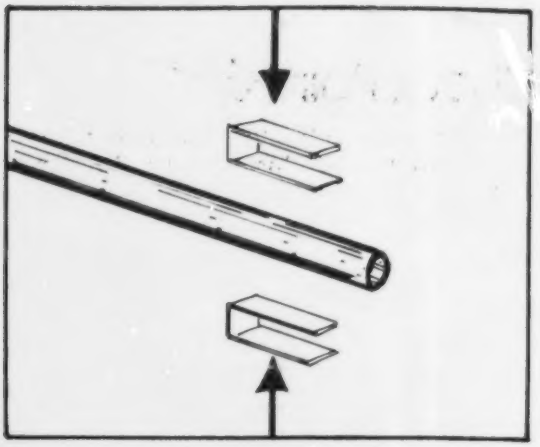
Instructional Objective VII

Given the proper tools and equipment, the student will prepare the stand to be welded.

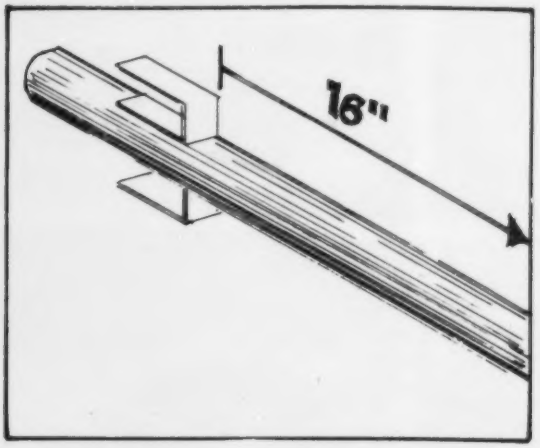


STEP 1 – In the welding area, place the metal pipe in a vise. Be sure the pipe is clamped in the bottom rounded jaws of the vise.

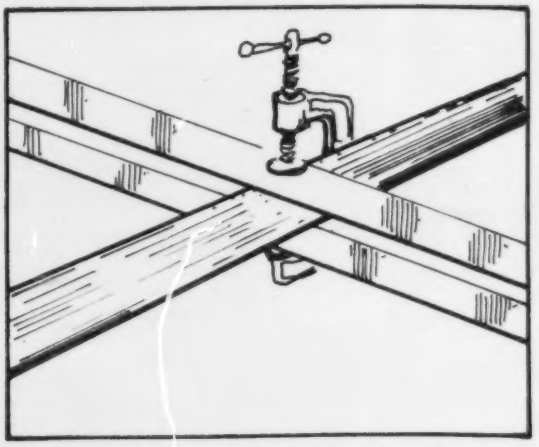
STEP 2 – Using the ruler and awl, measure and mark 5 inches (12.7 cm) from the top of the stand.



STEP 3 – At this point clamp both formed pieces of metal on each side of the pipe.



STEP 4 – Measure 16 inches (40.64 cm) from the bottom of the bent metal and mark this point with the awl.



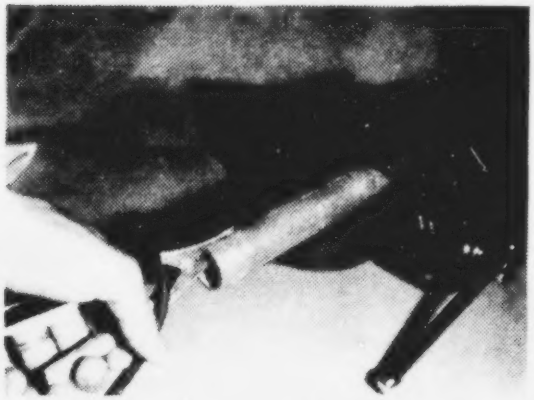
STEP 5 – Clamp both 18 inch (45.7 cm) pieces of metal on each side of the pipe. Be sure you have clamped this metal on the center line marked in Instructional Objective VI.

Check Point

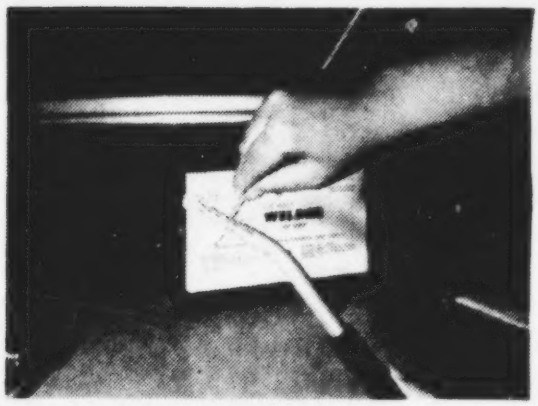
Have your instructor inspect your work before attempting Instructional Objective VIII.

Instructional Objective VIII

Given an arc welder and personal protective devices, the student will set up the arc welder for welding.



STEP 1 – Secure the ground clamp to one end of the metal.



STEP 2 – Place an electrode in the electrode holder.

STEP 3 – The welder is not ready for operation. For safety reasons it is important that you and your fellow students follow all these directions accurately.

STEP 4 – Put the leather apron on to protect your clothes from the sparks given off by the arc.

STEP 5 – Put the helmet on your head and adjust the band so the shield can be raised or lowered by using one hand.

STEP 6 – Never view or operate an arc welder without eye protection. Exposure of the bright light of the arc welder to the naked, unprotected eye will result in permanent eye damage or blindness.

STEP 7 – Always wear leather gloves around the welding area. These gloves may seem awkward but the protection they provide will be most beneficial. Always assume that a piece of metal is hot when you pick it up.

Check Point

Now you are ready to weld.

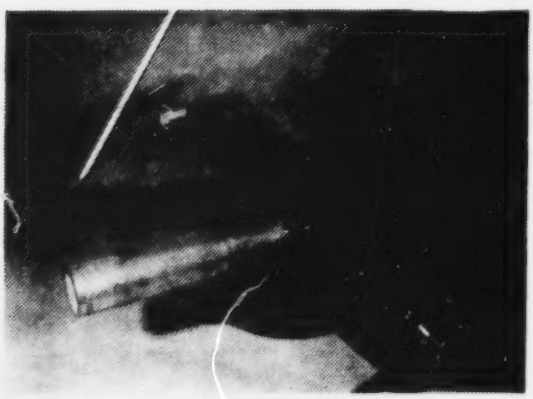
Have a classmate or instructor recheck this list:

1. welding amp knob at 75 amps
2. ground clamp secure
3. electrode in holder
4. leather apron on
5. welding helmet on
6. welding gloves on

Instructional Objective IX

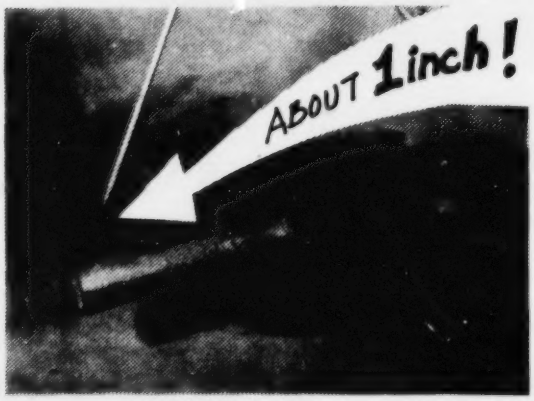
Given the welder, the student will strike an arc and weld the various pieces of metal together.

STEP 1 – Do not try to weld every piece at the same time. If you have never operated a welder before, it may take you 10 to 15 minutes to get the "feel" of the welding operation.

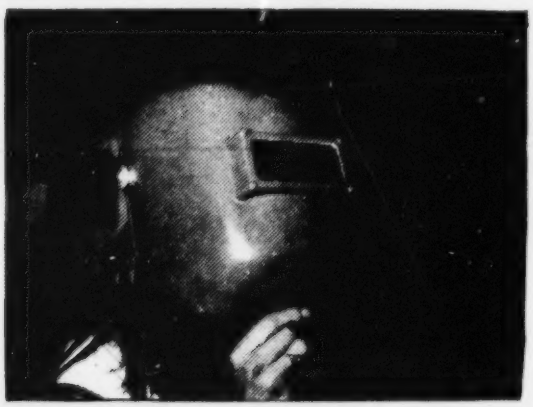


STEP 2 – Hold the electrode holder away from any metal.

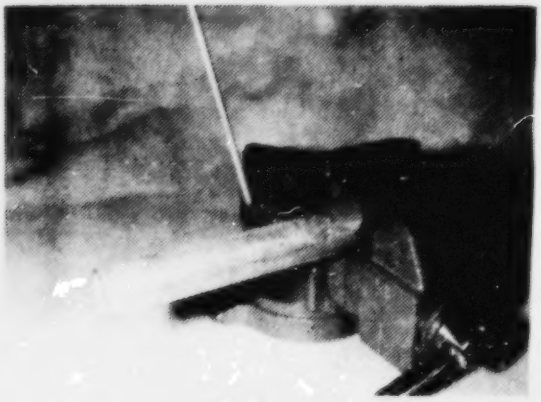
STEP 3 – Turn the welder on-off switch to the "on" position.



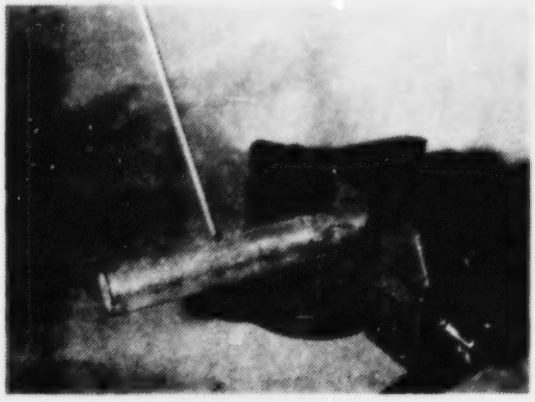
STEP 4 – Using the electrode holder, guide the tip of the electrode about 1 inch (2.54 cm) from the metal.



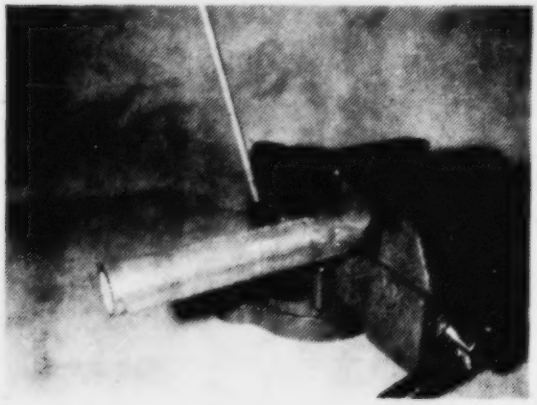
STEP 5 – With your free hand, pull the face shield down to protect your eyes. (Caution: Do not worry if you cannot see anything. When the arc is started the work area will be easy to view.)



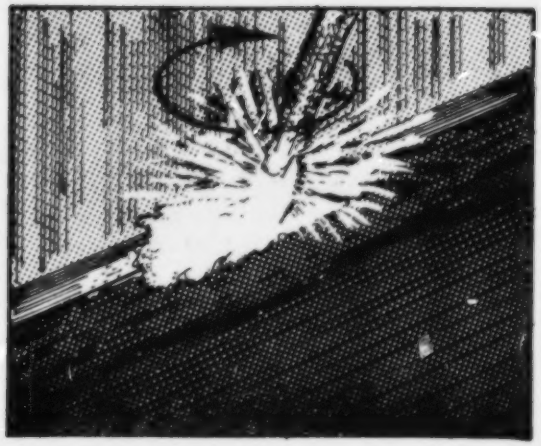
STEP 6 – Using a sweeping motion (like striking a wooden match against concrete) start the welder.



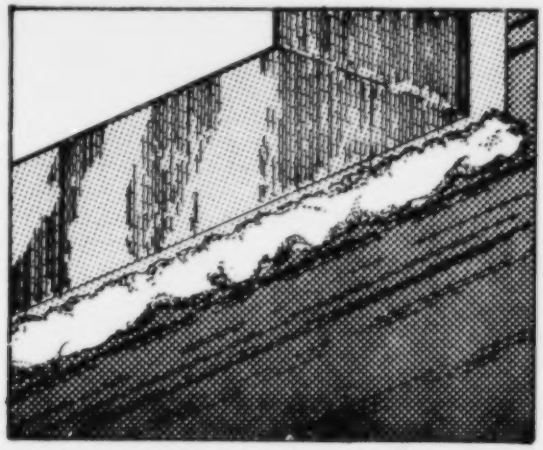
STEP 7 – If the electrode sticks to the metal, turn the welder off and free the electrode by hand. Repeat steps 1 – 6.



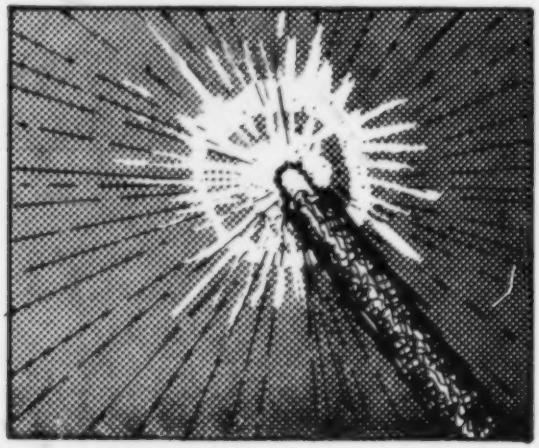
STEP 8 – Start the sweeping motion by making fast passes over the surface. Gradually slow this motion until the arc remains constant.



STEP 9 – By using small circular motions both pieces of metal will soon join in a pool of hot molten metal.



STEP 10 – When the entire length of metal has been joined, turn the welding switch to the "off" position.



STEP 11 – Continue steps 1 – 10 until all the metal has been welded to the pipe.

Check Point

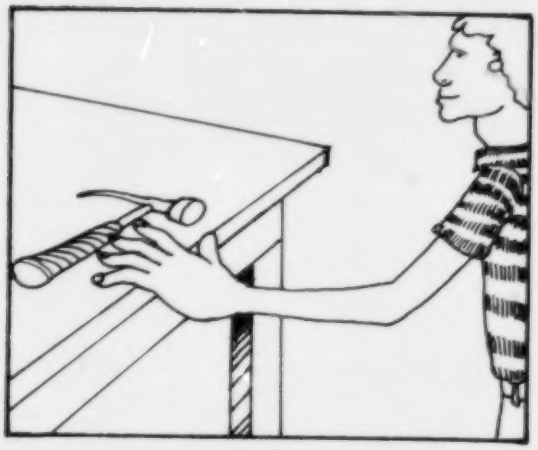
Have a fellow student or instructor help you set this up.

If this is your first attempt at arc welding, the extra hands will be useful.

Be sure all areas are welded on the pipe.

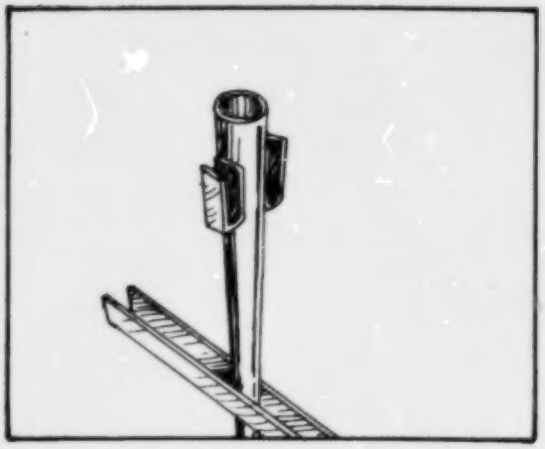
Instructional Objective X

Given chipping hammer and safety goggles, the student will clean and inspect the welds.

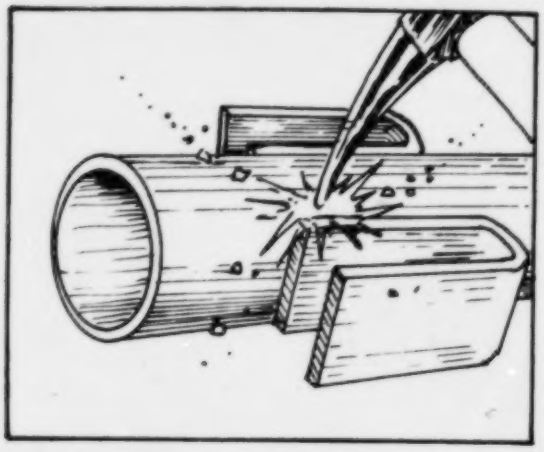


STEP 1 – Get a chipping hammer.

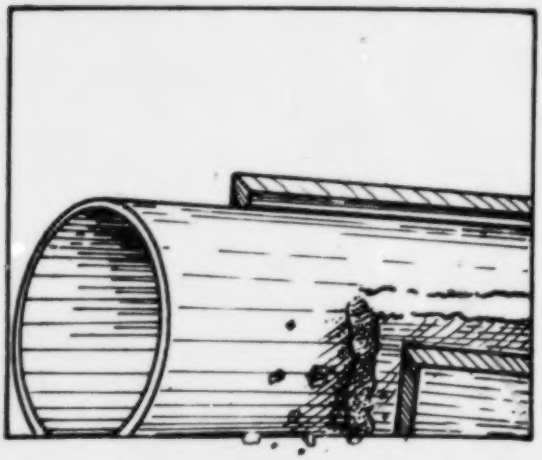
STEP 2 – Wear a pair of safety goggles.



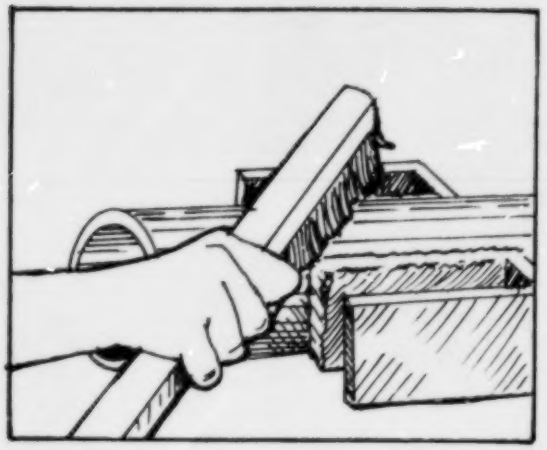
STEP 3 – When the stand has cooled, take it to an area where no students are working.



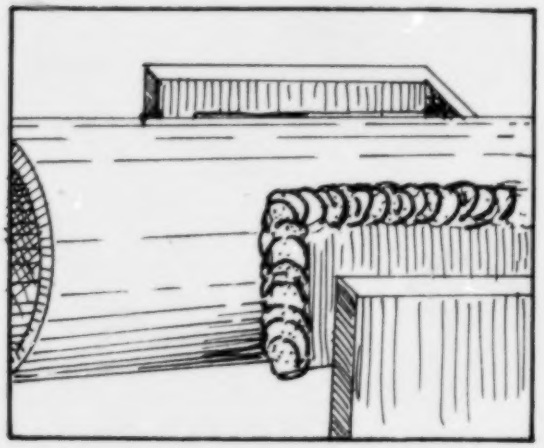
STEP 4 – Using the chisel end of the hammer, strike the welded area of the metal.



STEP 5 – A crust-type material will fall from the weld. This material is called slag. It contains the dirt and impurities found on the metal.



STEP 6 – After chipping all the slag off, turn the chipping hammer over and use the wire brush to remove any small slag deposits in your weld.



STEP 7 – A proper weld will resemble this illustration.

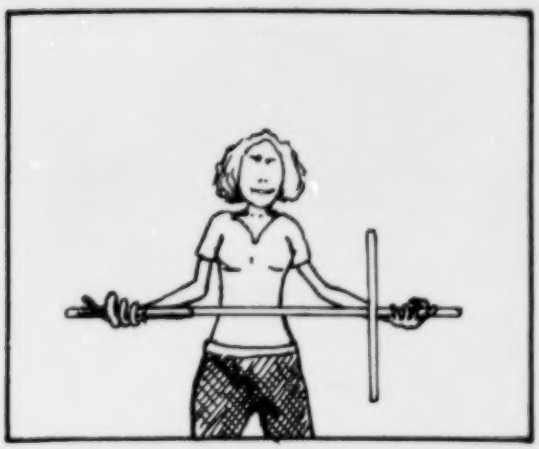
Check Point

If your metal fell off the pipe while cleaning, it must be rewelded to the surface.

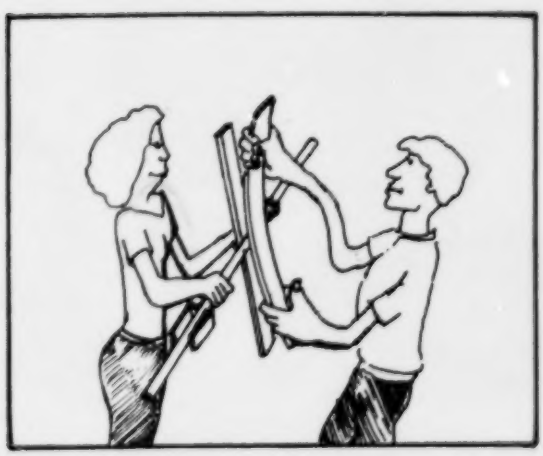
If your welds have held, proceed to the next instructional objective.

Instructional Objective XI

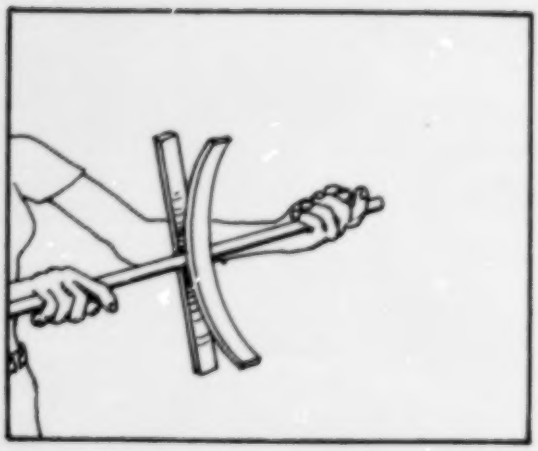
Given the necessary materials and instructions, the student will form the base of the trash can holder.



STEP 1 – Have a student hold each end of the pipe.



STEP 2 – Grasp each end of one side of the 18 inch (45.7 cm) metal pieces.



STEP 3 – Bend these pieces in opposite directions to form a quarter circle.

STEP 4 – Go to the other side of the 18 inch (45.7 cm) pieces of metal.

STEP 5 – Repeat steps 1 – 3 to form a half circle at the base of the holder.

Check Point

Have your instructor inspect the finished product.

810 ARC WELDERS AND CUTTERS

This group includes occupations concerned with welding processes in which joining is produced by heating with an arc or arcs, with or without the application of pressure and with or without the use of filler metal.

810.384-014 WELDER, ARC (welding)

Welds together metal components of such products as pipelines, automobiles, boilers, ships, aircraft, and mobile homes, as specified by layout, blueprints, diagram, work order, welding procedures, or oral instructions, using electric arc-welding equipment: Obtains specified electrode and inserts into portable holder or threads consumable electrode wire through portable welding gun. Connects cables from welding unit to obtain amperage, voltage, slope, and pulse, as specified by WELDING ENGINEER (profess. & kin.) or WELDING TECHNICIAN (profess. & kin.). Starts power supply to produce electric current. Strikes (forms) arc which generates heat to melt and deposit metal from electrode to workpiece and join edges of workpiece. Manually guides electrode or gun along weld line, maintaining length of arc and speed of movement to form specified depth of fusion and bead, as judged from color of metal, sound of weld, and size of molten puddle. Welds in flat, horizontal, vertical, or overhead positions. Examines weld for bead size and other specifications. May manually apply filler rod to supply weld metal. May clean or degrease weld joint or workpiece, using wire brush, portable grinder, or chemical bath. May repair broken or cracked parts and fill holes. May prepare broken parts for welding by grooving or scarfing surfaces. May chip off excess weld, slag, spatter, using hand scraper or power chipper. May preheat workpiece, using hand torch or heating furnace. May position and clamp workpieces together or assemble them in jig or fixture. May tack assemblies together. May cut metal plates or structural shapes [ARC CUTTER (welding)]. May be designated according to type of equipment used as WELDER, CARBON ARC (welding); WELDER, FLUX-CORED ARC (welding); WELDER, GAS-METAL ARC (welding); WELDER, GAS-TUNGSTEN ARC (welding); WELDER, HAND, SUBMERGED ARC (welding); WELDER, PLASMA ARC (welding); WELDER, SHIELDED-METAL ARC (welding). May be designated according to product welded as WELDER, BOILERMAKER (boilermaking). Important variations include types of metals welded, subprocesses used, trade name of equipment used, worksite (inplant, job shop, construction site, shipyard), method of application (manual, semiautomatic), high production or custom, level of ambidexterity required, type of joints welded (seam, spot, butt). May be required to pass employer performance tests or standard tests to meet certification standards of governmental agencies or professional and technical associations.